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Winter Diets of Stone's Sheep, Rocky Mountain Elk and Mule Deer: Peace Arm and Ospika River Drainages

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1.0 INTRODUCTION

Winter is a critical period for many ungulates as seasonal conditions have an increasing impact on their survivorship. Not only are the animals more susceptible to predation when they are concentrated on their wintering areas, but their food resource is less accessible and greater energetic demands are placed upon them. By ensuring that sufficient forage of suitable quality is available, however, there is a greater likelihood that they will meet their energetic requirements and survive the hardships of winter. Therefore, the first step in providing forage for a particular ungulate species is to identify what forage species are being consumed and, subsequently, identify those populations that are most likely to benefit from range manipulation practices (e.g., prescribed burning) to increase the abundance of favourable forage species.

Few studies exist in the literature that document thinhorn sheep diets: Stone's sheep, *Ovis dalli stonei* (Seip and Bunnell 1985, Geist 1971) and Dall sheep, *Ovis dalli dalli* (Elliott and McKendrick 1984, Geist 1971). These studies indicate, however, that winter thinhorn sheep diets are similar to bighorn sheep *(Ovis canadensis)* diets, consisting primarily of grasses with lesser amounts of shrubs and forbs (Wikeem and Pitt 1992, Goodson et al. 1991a, Shank 1982, Johnson and Smith 1980, Nichols 1978, Geist 1971).

The diet of Rocky Mountain elk *(Cervus canadensis nelsoni)* is diverse, matching the vegetation communities that they inhabit. Grasses and shrubs generally constitute the majority of their winter diet, with grasses - depending on snow conditions - selected most often (McCorquodale 1993, Jenkins and Wright 1986, Nelson and Leege 1982, Hobbs et al. 1981, Boyd 1978). Similarly, mule deer *(Odocoileus hemionus hemionus)* diets vary, but in winter mule deer are characterised as browsers as they feed primarily on shrub and conifer foliage (Armleder and Dawson 1992, Wallmo and Regelin 1981, Wallmo 1978). Mule deer have also been reported to feed on arboreal lichens when wintering in mature conifer stands (Dawson et al. 1990).

Although some diet composition information is available on sheep, elk and deer, their dietary intake varies with forage availability, and therefore among habitats and geographic location. This report documents the winter diet of Stone's sheep, Rocky Mountain elk and mule deer from different locations within the Williston Reservoir watershed for the purpose of directing future habitat enhancements. As a preface, a review of the techniques used by researchers to determine the diet of ungulates is also presented.

2.0 REVIEW OF TECHNIQUES

Several authors have stated that fecal fragment analysis is one of the most useful tools for studying diets of wild ungulates (Holechek et al. 1982, Anthony and Smith 1974, Todd and Hansen 1973). However, other researchers have discussed the problems and inconsistencies of fecal fragment analysis to adequately estimate diets for animals, such as ungulates, that feed on a diversity of plant material (Lewis 1994, Boertje et al. 1985, Gill et al. 1983, Shank 1982).

Studies have revealed that plants do not occur in the feces of animals in the same proportion as they were consumed due to differences in the rate of digestion among plant species, parts and phenological stage (Boertje et al. 1985, Gill et al. 1983, Fitzgerald and Waddington 1979, Deardon et al. 1975, Anthony and Smith 1974, Zyznar and Urness 1969). Highly digestible plants such as lichens are typically underestimated, while less digestible plant species (mosses and conifers) are overestimated in the diet (Anthony and Smith 1974, Thomas and Kroeger 1980, Sulkava et al. 1983, Leslie et al. 1984). Some plants or plant parts such as mushrooms and flowers may not be detected at all (Anthony and Smith 1974, Boertje et al. 1985), though this is likely not a problem when studying winter diets. Errors also occur because of differential recognition of forage items that are present (Gill et al. 1983). This may be confounded as reference collections used to identify the particular plant species need to reflect the different phenological stages of the plant.

Deardon et al. (1975) noted that mosses fragment more and are still identifiable, thereby causing an underestimation of the other foliage consumed. Consequently, researchers such as Deardon et al. (1975) and Voth and Black (1973) developed correction factors for individual forage species to better approximate their dietary composition. Correction factors, however, have also come under scrutiny as they are (1) specific to the forage species, animal species and individual animal studied, and (2) dependent on the proportion and mixtures of the different forage species and classes present (Baker and Hansen 1985, Gill et al. 1983, Boertje et al. 1985). Boertje et al. (1985) recommended that correction factors be restricted to winter diets, and developed for each study.

Other techniques used to estimate the diets of wild animals include rumen content analysis, direct observations of foraging animals, and observation of plants for evidence of foraging. These too have their drawbacks. The use of rumen samples to estimate diets requires the animal

to be killed and represents a single animal's dietary intake over a relatively short feeding period (Nelson and Leege 1982, Lewis 1994). There are also biases induced when preparing the samples for analysis (Lewis 1994), and from differences in digestibility similar to fecal analyses. The location in the rumen from which the sample was collected may also affect the composition results.

Direct observations involve bite-counts or timed feeding bouts that are tedious, time-consuming and, unless in close proximity to the animal (<25 m), difficult to quantify (Wallmo et al. 1973, Nelson and Leege 1982, Johnson and Smith 1980). The close proximity that is required may also cause a problem when dealing with wild animals in field settings, particularly in winter. Wallmo et al. (1973) found that inaccurate diet estimations, even at the class level (e.g. graminoids, forbs, shrubs), can be made using direct observations because of differences in observer proximity, misidentification of forage and observer variability. If tame animals are used to represent the wild animal, diets may be misrepresented because of their lack of familiarity with the forage species available and the "feeding" area presented to them.

Examining plants for evidence of foraging (e.g., forage utilisation surveys) is another technique employed to identify what plants are being consumed in the study area. Unfortunately, feeding sites of wild ungulates are usually scattered widely and foraged upon lightly, therefore requiring intensive sampling (Nelson and Leege 1982). Also, this technique is impossible when multiple species use the same area and forage types at the same time of year, a common occurrence with overlapping ungulate populations (e.g., deer, elk, moose).

Although fecal fragment analysis has its faults, the technique does allow one to:

1. collect a large number of samples within a short period of time, and at a relatively low cost.
2. collect samples without killing the animal, or disrupting the animal's natural foraging behaviour. Fecal samples also represent a longer feeding interval than rumen samples and direct observations.
3. be specific to the wildlife species being studied.
4. identify the majority, if not all, of the plant species ingested (particularly in winter).
5. obtain an estimate of the proportion of food (forage class) consumed.
6. provide a diet estimate for a population, herd or animals in a particular area, by using composite samples; this does, however, result in a reduced sample size and loss of sample variability.
7. identify seasonal changes in diet composition.

For the above reasons, fecal fragment analysis continues to be used to determine diets of ungulates and other wildlife species. Caution should be used, however, when making comparisons among plant species and different geographic areas.

3.0 METHODS AND AREA DESCRIPTIONS

3.1 PELLET COLLECTION AND ANALYSIS

Winter fecal pellet samples were collected between 19 December 1990 and 15 March 1991, and between 29 November 1991 and 17 March 1992. A fecal pellet sample consisted of 2 to 3 pellets, dependent on pellet size, selected from each of 5 to 10 pellet groups. One sample was collected at each site for each time period (month). Pellets were collected from the surface of the existing snow. The wildlife species that deposited the pellets was discerned by the shape and size of the pellet, and the associated sign in the area (e.g., tracks).

Following their collection, samples were oven-dried (65°C) for 24 to 36 hours. Diets were determined using fecal fragment analysis conducted by the Wildlife Habitat Laboratory, Washington State University, Pullman, Washington. Six microscopic slides were made per sample and 25 views were examined, for a total of 150 views per sample.

Composition of each sample was determined for forage classes and select taxa; only forage classes and the most common taxa are presented. Forage classes were graminoids (grasses, sedges and rushes), forbs, shrubs, conifers, mosses, lichens and *other* (insects, ferns and unidentifiable plant material). No correction factors were used to correct for potential differences in plant digestibilities.

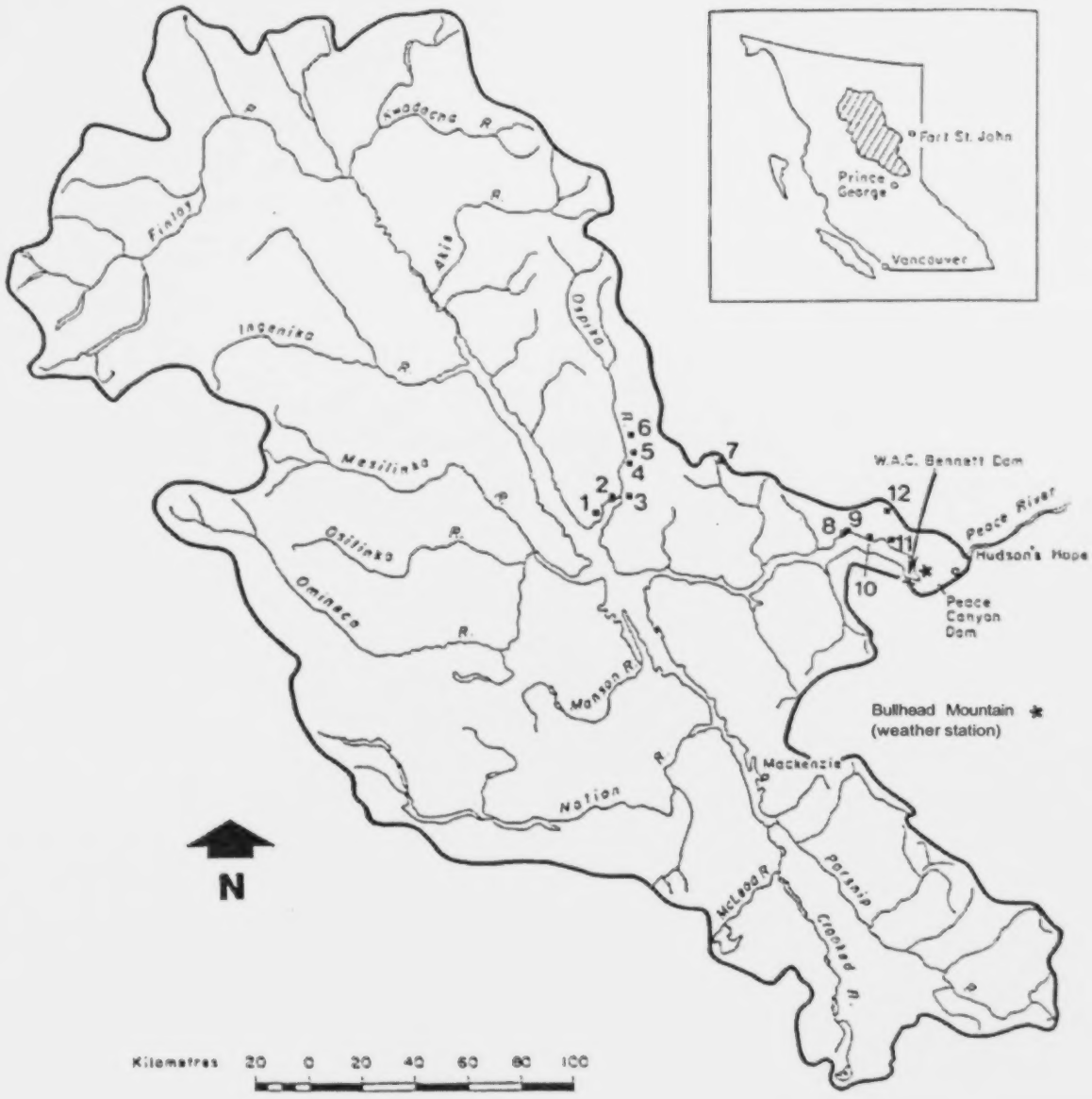
The accuracy of fecal fragment analysis to estimate the diets of *mixed-feeder* ungulates is dependent on the type and proportion of vegetation consumed (see *Review of Techniques).* For this reason, only forage class comparisons will be made between different geographic areas of the watershed (e.g., Ospika vs. Peace) and other studies. Although composition cannot be compared statistically, the results still provide important information on the forage species and classes most represented in the animal's diet for a specific geographic area in the Williston Reservoir watershed.

3.2 COLLECTION SITES

Fecal pellet samples were collected from the Peace Arm drainage (sheep, elk and deer) and the lower Ospika River drainage (deer and elk) of the Williston Reservoir watershed (Figure 1). Within the Peace Arm drainage, fecal samples for Stone's sheep were collected from three separate sites: Rainbow Rocks, Butler Ridge and Nabesche River (Appendix A). Butler Ridge and Nabesche River sites are located within the Alpine Tundra (AT) biogeoclimatic zone, while Rainbow Rocks is situated in the moist, warm Boreal White and Black Spruce biogeoclimatic subzone (BWBSmwl) (Thompson and Lacelle 1992, DeLong et al. 1990). The AT collection sites were above 1500 m in elevation, and the Rainbow Rocks site was between 700-800 m.

Elk and mule deer fecal samples were collected from the trembling aspen *(Populus tremuloides)* -grass/shrubland areas along the north shore of the Peace Arm (R. J. Backmeyer, personal communication), and from conifer forests in the lower Ospika River drainage (J. Sundve, personal communication) (Figure 1). The Peace Arm collection sites included four areas (<850 m in elevation) between Adams and Gravel Hill Creeks: Rainbow Rocks, east and west of Dunlevy Creek, and the area near the Forest Service weather station (Appendix A). All four sites were within the BWBSmwl (Thompson and Lacelle 1992). In the Ospika River drainage, samples from mule deer were collected near the Ospika logging camp, and elk samples were collected from five different locations adjacent to the lower section of the Ospika River: north side of Ospika Arm, Gauvreau and Alley Creeks, and areas near the Ospika River bridge and J. Sundve's trapper cabin (Appendix A). All collection sites within the Ospika River drainage were located in conifer forests (<880 m elevation) of the moist, cool Sub-Boreal Spruce (SBSmk2) biogeoclimatic subzone (Clement et al. 1991).

Conifer forests of the SBSmk2 are dominated by hybrid white spruce *(Picea glauca x engelmannii)* with subalpine fir *(Abies lasiocarpa);* lodgepole pine *(Pinus contorta)* being on drier sites (Clement et al. 1991). The BWBSmwl collection sites featured trembling aspen as the common seral species, with numerous openings - created by prescribed burning - supporting grasses and forbs (R. Backmeyer, personal communication). The AT is devoid of trees, and is dominated by lichens, mosses, herbs and shrubs (Thompson and Lacelle 1992). Much of the AT landscape is also characterised by rock outcroppings and talus slopes, with minimal vegetation (Thompson and Lacelle 1992). During winter, AT has areas of wind-swept



OSPIKA RIVER DRAINAGE

1. Ospika logging camp
2. Ospika Arm (north)
3. Gauvreau Creek
4. Ospika River bridge
5. Sundve cabin
6. Aley Creek

PEACE ARM DRAINAGE

7. Nabesche River
8. Rainbow Rocks
9. Forest Service weather station
10. Dunlevy Creek (west)
11. Dunlevy Creek (east)
12. Butler Ridge

Figure 1. Fecal pellet collection sites for Stone's sheep, Rocky Mountain elk and mule deer in the Williston Reservoir watershed: Ospika River and Peace Arm drainages.

slopes and regions of compact snow; the extent that these areas are present is dependent on the severity of winter weather conditions.

The Bullhead Mountain weather station (790 m), southeast of the Peace Arm collection sites (Figure 1), registered two consecutive years of record or near record snow depths for the months of January, February and March in 1991 and 1992; January to March snow depths for these two years ranged from 38 cm to 53 cm, while the previous eight-year means were 24 cm to 29 cm (Water Management Division 1994). Snow depths measured 29 January and 26 February 1991, along the north shore of the Ospika Arm averaged 50 cm and 34 cm, respectively (Corbould and Martin *in prep).* During the same period, snow depths at the confluence of Aley Creek and the Ospika River were greater than 1 m.

4.0 RESULTS AND DISCUSSION

4.1 STONE'S SHEEP

Stone's sheep diets appeared to be quite similar between collection dates for a specific site, but were found to differ between collection sites (Table 1). Plant fragments from pellets collected from the Rainbow Rocks site were dominated by graminoids (77% on average; n = 4), with shrubs (14%) and forbs (6%) present to a much lesser extent. In contrast, the Nabesche River pellet samples contained predominantly forbs (50%; n = 1) and mosses (25%), and the Butler Ridge samples indicated terrestrial lichens to be the dominant forage (43% on average; n = 2) (Table 1). Grasses represented a smaller proportion of the diet at both alpine sites (Nabesche River [12%] and Butler Ridge [18%]), compared to the lower elevation Rainbow Rocks site.

Lichens probably represented an even higher proportion of the diet because of their greater digestibility. The substantial component of mosses and lichens found in the sheep diets at alpine sites is unlikely due strictly to low digestibility of mosses and/or incidental consumption.

Wikeem and Pitt (1992) found that bighorn sheep selected their forage based primarily on plant availability. This suggests that the availability of graminoids was limiting in the alpine sites in the winter, as lichen and moss typically play a minor part in thinhorn sheep diets (Nichols 1978, Elliott and McKendrick 1984, Seip and Bunnell 1985a). I suspect that snow-free, windblown areas were the only feeding sites available during these winters because Seip and Bunnell

Table 1. Winter diets (% dry weight), determined by fecal fragment analysis, of Stone's sheep from the Nabesche River, Rainbow Rocks and Butler Ridge sites (Peace Arm drainage, Williston Reservoir watershed). Each column represents the composition of one sample. Forage class totals (in brackets) and main plant taxa are presented.

	Nabesche	Rainbow Rocks					Butler Ridge		
Class/Species	Mar/91	Mar/91	Nov/91	Jan/92	Mar/92	mean	Dec/91	Mar/92	mean
Graminoids (total)	**(12.3%)**	**(78.9%)**	**(70.8%)**	**(75.7%)**	**(81.5%)**	**(76.7%)**	**(14.0%)**	**(22.8%)**	**(18.4%)**
Calamagrostis canadensis		7.7%	12.9%	11.3%	16.3%		2.6%	2.5%	
Elymus innovatus	2.9%	16.1%	26.1%	29.8%	35.2%		7.9%	12.2%	
Oryzopsis spp.		0.3%	18.3%	21.6%	14.9%		1.2%	0.5%	
Poa spp.		15.1%							
Sedges/rushes	1.4%	19.0%	9.9%	12.0%	12.5%		2.0%	6.7%	
Forbs (total)	**(49.6%)**	**(8.0%)**	**(8.8%)**	**(4.1%)**	**(4.1%)**	**(6.3%)**	**(6.5%)**	**(3.6%)**	**(5.0%)**
Equisetum spp.	11.9%								
Oxytropis spp.	12.2%								
Petasites palmatus	8.2%								
Shrubs (total)	**(9.4%)**	**(2.3%)**	**(19.7%)**	**(19.1%)**	**(13.7%)**	**(13.7%)**	**(14.4%)**	**(14.8%)**	**(14.6%)**
Artemisia frigida			1.7%	1.3%				0.7%	
Salix spp.			16.5%	15.0%	13.4%		12.2%	10.4%	
Conifers (total)							**(1.0%)**	**(0.1%)**	**(0.6%)**
Mosses (total)	**(25.3%)**	**(10.4%)**	**(0.2%)**		**(0.2%)**	**(2.7%)**	**(7.0%)**	**(11.9%)**	**(9.4%)**
Lichens (total)	**(3.4%)**	**(0.4%)**		**(0.9%)**	**(0.5%)**	**(0.4%)**	**(55.9%)**	**(46.1%)**	**(51.0%)**
Arboreal [total]							[11.7%]	[4.8%]	[8.2%]
Alectoria spp.							11.2%	4.7%	
Bryoria spp.							0.5%	0.1%	
Terrestrial [total]							[44.2%]	[41.3%]	[42.8%]
Cetraria spp.							5.0%	2.1%	
Cladonia/Cladina spp.							13.6%	7.5%	
Dactylina spp.							8.2%	5.3%	
Peltigera spp.							13.5%	22.7%	
Other			**(0.5%)**	**(0.2%)**		**(0.2%)**	**(1.2%)**	**(0.7%)**	**(1.0%)**
TOTAL	100%	100%	100%	100%	100%	100%	100%	100%	100%

(1985) found Stone's sheep to consume a high percentage of lichen (36%) only when the sheep were restricted to windswept alpine areas during a high snowfall year. In less severe snowfall years, lichen consumption was less than 10%.

Snow cover is the most important factor affecting food availability for Stone's sheep and, when snow depths exceed 30cm, sheep stop digging even though abundant food is beneath (Seip and Bunnell 1985). Goodson et al. (1991*b*) similarly found that even small amounts of snow (<12cm) had an significant negative effect on foraging efficiency and diet quality of bighorn sheep. The two consecutive years of record or near record snow depths for the months January

to March in 1991 and 1992 (>38 cm; Water Management Division 1994) likely limited the number and extent of snow-free areas during these years, thus restricting the availability of preferred graminoid forage to sheep.

4.2 ROCKY MOUNTAIN ELK

Peace Arm Drainage

Plant fragments in winter elk fecal pellets from the aspen/grassland habitats on the north shore of the Peace Arm were dominated by graminoids (63%; n = 5) and shrubs (23%) throughout the winter (Table 2). Early winter samples (Nov. and Jan.) also contained a moderate amount of forbs (18%; n = 3). As in the sheep diets, the most common grasses included *Elymus innovatus* (fuzzy-spiked wildrye), *Oryzopsis* spp. (ricegrasses) and *Calamagrostis canadensis* (bluejoint). *Salix* spp. (willows) were the primary shrub species. These diets are similar to elk utilising similar habitats in Colorado and Washington (Hobbs et al. 1981, McCorquodale 1993). McCorquodale reported that elk in Washington's shrub-steppe habitat browsed shrubs heavily when snow covered the ground ($\geq$10cm); however, when the ground was virtually snow-free, diets were dominated by grasses.

Ospika River Drainage

From conifer sites in the lower Ospika River drainage, fecal plant fragment results for elk were quite different than in the Peace Arm drainage. Lichen was the dominant forage (47% on average; n = 5), except at two sites where shrubs represented an equal or greater amount (Table 2). Graminoids were present to a much lesser extent in the diets of elk in the Ospika than in the Peace, likely a result of their reduced availability due to deeper snow depths.

Winter diets are reported to be influenced strongly by forage availability, a consequence of snow conditions. In Montana, elk were observed to move into conifer stands during a harsh winter when snow depths exceeded 60 cm (Jenkins and Wright 1986). And, when elk wintered in mature conifer forests in Montana and Idaho, the presence of conifer increased in their diets, and arboreal lichens were also consumed (Hash [1973] and Bohne [1974] *in* Nelson and Leege 1982). No studies have reported elk to consume such a high amount of lichen as identified in this study.

Table 2. Winter diets (% dry weight), determined by fecal fragment analysis, of Rocky Mountain elk from sites along the north shore of the Peace Arm and in the lower Ospika River drainage, Williston Reservoir watershed. Each column represents the composition of one sample. Forage class totals (in brackets) and main plant taxa are presented.

Class/Species	Peace Arm (north shore)						Lower Ospika River					
	W. Dunl. Nov/91	E. Dunl. Nov/91	Rainbow Jan/92	Wx Stn Mar/92	W. Dunl. Mar/92	mean	Osp Arm Dec/90	Osp Brg Jan/91	Aley Ck Feb/91	Gauv Ck Mar/91	Cabin Mar/91	mean
Graminoids (total)	(55.2%)	(70.8%)	(56.3%)	(64.8%)	(68.4%)	(63.1%)	(6.7%)	(8.1%)	(10.0%)	(19.0%)	(12.5%)	(11.3%)
Calamagrostis canadensis	7.7%	31.4%	6.6%	6.4%	6.6%		2.8%			4.4%	2.7%	
Elymus innovatus	30.1%	8.5%	20.8%	29.6%	29.3%				5.1%			
Oryzopsis spp.	9.4%	12.8%	19.3%	23.9%	20.6%		1.4%	3.7%		2.1%	1.1%	
Festuca/Poa spp.	2.8%	4.5%	1.6%	1.8%	2.9%			0.2%	2.2%	5.9%		
Sedges/rushes	0.7%	10.6%	4.9%	0.5%	6.6%		2.3%	3.0%	0.5%	1.2%	6.2%	
Forbs (total)	(13.2%)	(17.0%)	(23.3%)	(5.6%)	(5.4%)	(12.9%)	(15.5%)	(18.8%)		(1.8%)	(13.0%)	(9.8%)
Equisetum spp.							15.5%	18.1%			12.4%	
Shrubs (total)	(31.5%)	(12.2%)	(18.3%)	(28.3%)	(25.7%)	(23.2%)	(1.1%)	(5.0%)	(41.7%)	(54.9%)	(3.1%)	(21.2%)
Amelanchier alnifolia									0.9%	5.7%		
Rosa acicularis									3.7%	5.9%		
Salix spp.	28.5%	9.8%	12.7%	22.9%	20.6%				16.1%	11.3%	0.2%	
Viburnum edule									2.9%	9.4%	1.0%	
Conifers (total)				(1.3%)		(0.3%)	(7.9%)	(9.8%)	(4.3%)	(4.7%)	(9.8%)	(7.3%)
Abies/Picea spp.							2.8%	3.6%	1.9%		3.9%	
Conifer bark							4.8%	5.3%	1.6%	3.7%	5.9%	
Mosses (total)							(2.8%)	(4.9%)	(0.3%)		(10.1%)	(3.6%)
Lichens (total)	(0.1%)						(66.0%)	(52.5%)	(43.7%)	(19.6%)	(51.3%)	(46.6%)
Arboreal [total]							[32.1%]	[25.7%]	[18.6%]	[16.4%]	[26.7%]	[23.9%]
Alectoria spp.							25.7%	23.8%	14.5%	12.6%	22.5%	
Bryoria spp.							6.4%	1.9%	4.1%	3.8%	4.2%	
Terrestrial [total]							[33.9%]	[26.8%]	[25.1%]	[3.2%]	[24.6%]	[22.7%]
Cladonia/Cladina spp.							0.1%	6.7%	1.3%		1.1%	
Peltigera aphthosa							28.8%	16.1%	14.9%	0.7%	18.3%	
Other			(2.1%)		(0.5%)	(0.5%)		(0.9%)		(0.3%)	(0.2%)	(0.3%)
TOTAL	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%

Roosevelt elk (*C. e. roosevelti)* in old-growth forests of western Washington foraged mainly on conifer trees in winter, even though little snowfall occurred (Leslie et al. 1984). The authors speculated that this elk population was at equilibrium with its food resource as the presence of shrubs, grasses and forbs was minimal in the study area; lichen was not present. Hodgman and Bowyer (1985) observed white-tailed deer *(Odocoileus virginianus)* - a species with similar foraging patterns to elk - to consume large amounts of arboreal lichens while wintering in conifer dominated forests in Maine. Hodgman and Bowyer related the heavy use of these lichens to their high digestibility, and moderate crude protein and energy values; the consumption of lichen declined rapidly when spring arrived and more succulent forage became available.

In our study, arboreal and terrestrial lichens appeared to be consumed in equal proportions, with *Alectoria* spp. and *Peltigera aphthosa* comprising the largest part of the lichen diet. *Peltigera* spp. have been found to have high digestibility and protein content (Thomas et al. 1984). The large component of terrestrial lichen indicates that cratering (digging) likely occurred to access these species; snow was up to 50 cm deep along the Ospika Arm and over 1 metre deep near Aley Creek. Sweeney and Sweeney (1984) and Jenkins and Wright (1986) observed that elk avoided areas with snow depths greater than 60-70 cm, and were located most often in areas with less than 40 cm.

4.3 MULE DEER

Peace Arm Drainage

Mule deer fecal samples from the Peace Arm revealed that graminoids, shrubs and conifers were the principal forage species (Table 3). In November and March, graminoids and shrubs represented over 80% of the diet, but in January, conifer (exclusively lodgepole pine) and shrubs provided the majority (85%) of the diet. The high occurrence of lodgepole pine in the January diet is presumably due to the deeper snow depths reducing the availability of grasses and shrubs; snow depths had decreased by >10 cm by the March collection date (17 Mar 1991) that graminoids were likely more accessible again. Willows were the primary shrub species browsed on throughout the winter (24-38% of the diet). Although mule deer are characterised as browsers, deer will likely forage on grasses rather than browse on conifers as grasses are more easily digested and provide greater nutrient value (Wallmo and Regelin 1981).

Table 3. Winter diets (% dry weight), determined by fecal fragment analysis, of mule deer for sites along the north shore of the Peace Arm and the lower Ospika River drainage, Williston Reservoir watershed. Each column represents the composition of one sample. Forage class totals (in brackets) and main plant taxa are presented.

Class/Species	Peace Arm (north shore)				Lower Ospika River			
	W. Dunl Nov/91	Wx Stn Jan/92	Wx Stn Mar/92	mean	Camp Dec/90	Camp Jan/91	Camp Mar/91	mean
Graminoids (total)	**(54.2%)**	**(10.2%)**	**(58.4%)**	**(40.9%)**	**(0.8%)**	**(1.0%)**	**(0.8%)**	**(0.9%)**
Calamagrostis canadensis	7.2%	0.3%	2.7%					
Elymus innovatus	20.2%	3.9%	28.1%					
Oryzopsis spp.	8.2%	0.6%	1.7%					
Festuca/Poa spp.	6.6%	4.3%	4.5%					
Forbs (total)	**(3.6%)**	**(4.2%)**	**(4.1%)**	**(4.0%)**	**(4.1%)**	**(4.4%)**	**(5.0%)**	**(4.5%)**
Shrubs (total)	**(39.2%)**	**(37.2%)**	**(25.1%)**	**(33.8%)**	**(54.1%)**	**(58.1%)**	**(47.7%)**	**(53.3%)**
Amelanchier alnifolia	0.2%				7.1%	0.6%	2.6%	
Artemisia frigida					12.4%	16.9%	14.1%	
Rosa acicularis						11.8%	0.2%	
Salix spp.	38.2%	32.8%	23.5%		12.5%	12.8%	18.9%	
Shepherdia canadensis					6.9%	6.8%	4.2%	
Conifers (total)	**(3.0%)**	**(48.4%)**	**(12.3%)**	**(21.2%)**	**(34.7%)**	**(32.1%)**	**(36.8%)**	**(34.5%)**
Pinus contorta	3.0%	48.4%	11.9%		12.4%	10.9%	18.0%	
Juniperus spp.					19.1%	17.5%	13.6%	
Mosses (total)			**(0.1%)**		**(1.5%)**		**(8.4%)**	**(3.3%)**
Lichens (total)					**(4.8%)**	**(4.4%)**	**(1.3%)**	**(3.5%)**
TOTAL	100%	100%	100%	100%	100%	100%	100%	100%

Ospika River Drainage

In the Ospika, shrub and conifer browse composed the bulk of the mule deer diet (>85% on average, n = 3) (Table 3). The high occurrence of browse species in the diet is consistent with other mule deer populations in conifer-dominated forest habitats (Armleder and Dawson 1992, Dawson et al. 1990, Wallmo 1978). In this study, willow, *Artemisia frigida* (pasture sage) lodgepole pine and *Juniperus* spp. (juniper) contributed roughly equally to the diet of mule deer, and represented a combined average of 60% of the total diet.

The presence of pasture sage and juniper however, uncharacteristic of SBSmk2 habitats, infers that deer are frequenting drier, coarse soiled microhabitats that are located presumably on south-facing slopes. The area surrounding the Ospika logging camp, with its comparatively low

snow depths (<60 cm; Corbould and Martin *in prep),* is one of the few known mule deer wintering sites along the Finlay Reach. Less than 5% of the Williston Reservoir watershed has snow depths suitable for wintering mule deer (Davidson and Dawson 1988). The greater snow depths, and concurrent reduced forage availability, are likely two key factors limiting the distribution of mule deer on the west side of the Rocky Mountains in the Williston Reservoir watershed.

5.0 RECOMMENDATIONS

1. **Enhancement sites:** forage enhancement activities (e.g., prescribed burning) should be considered at the Nabesche River and Butler Ridge sites if winter snow depths are determined to be acceptable (i.e., <30 cm for sheep, <40-60 cm for elk). Identifying and protecting key wintering areas (e.g., Rainbow Rocks for sheep), and maintaining snow-interception habitats (mature conifer stands) in areas where animals are known to over winter in deeper snow zones (e.g., lower Ospika River drainage for deer and elk) should also be encouraged.

2. **Effectiveness of habitat enhancements (prescribed burns)**: a select number of areas that have been previously burned should be monitored to assess their winter use by the targeted species, and vegetation response (i.e., what plant species are present, and are they being foraged upon?). In addition, for a select number of areas proposed to be burned, it would be beneficial to collect pellet samples and vegetation information before and after the burn to determine if diet and vegetation composition change.

3. **Sampling Technique:** continue to use fecal fragment analysis. But, to ensure that samples are representative of the means of individuals, equal weights of dried samples from each pellet group should be used, rather than an equal number of fecal pellets (Jenks et al. 1989).

4. **Sampling Design:** collect winter fecal samples from more than 1 year at each site as food habits can vary significantly between years and sites (Cooperrider et al. 1980). The level of sampling intensity required (and the resultant costs) to ensure statistically defensible conclusions is likely not warranted due to the scale and general objective (i.e., create early seral habitats) of prescribed burning. However, the collection of at least three samples from each site would be recommended to provide a more accurate account of the winter diet for

species considered (i.e., show the variance in diet composition), and aid in identifying coarse scale (e.g., forage class) differences between sites and before and after treatment.

6.0 SUMMARY

Stone's sheep, Rocky Mountain elk, and mule deer fecal samples were collected during the winter (December 1990 - March 1992) from the Ospika River and Peace Arm drainages, Williston Reservoir watershed. Plant fragment analysis showed that diets were similar, at the forage class level, to other studies from similar habitats in North America. However, sheep diets in the Nabesche River area (Peace Arm drainage) had a relatively high component of forbs and mosses, and elk diets in the lower Ospika River drainage contained mostly arboreal and terrestrial lichens.

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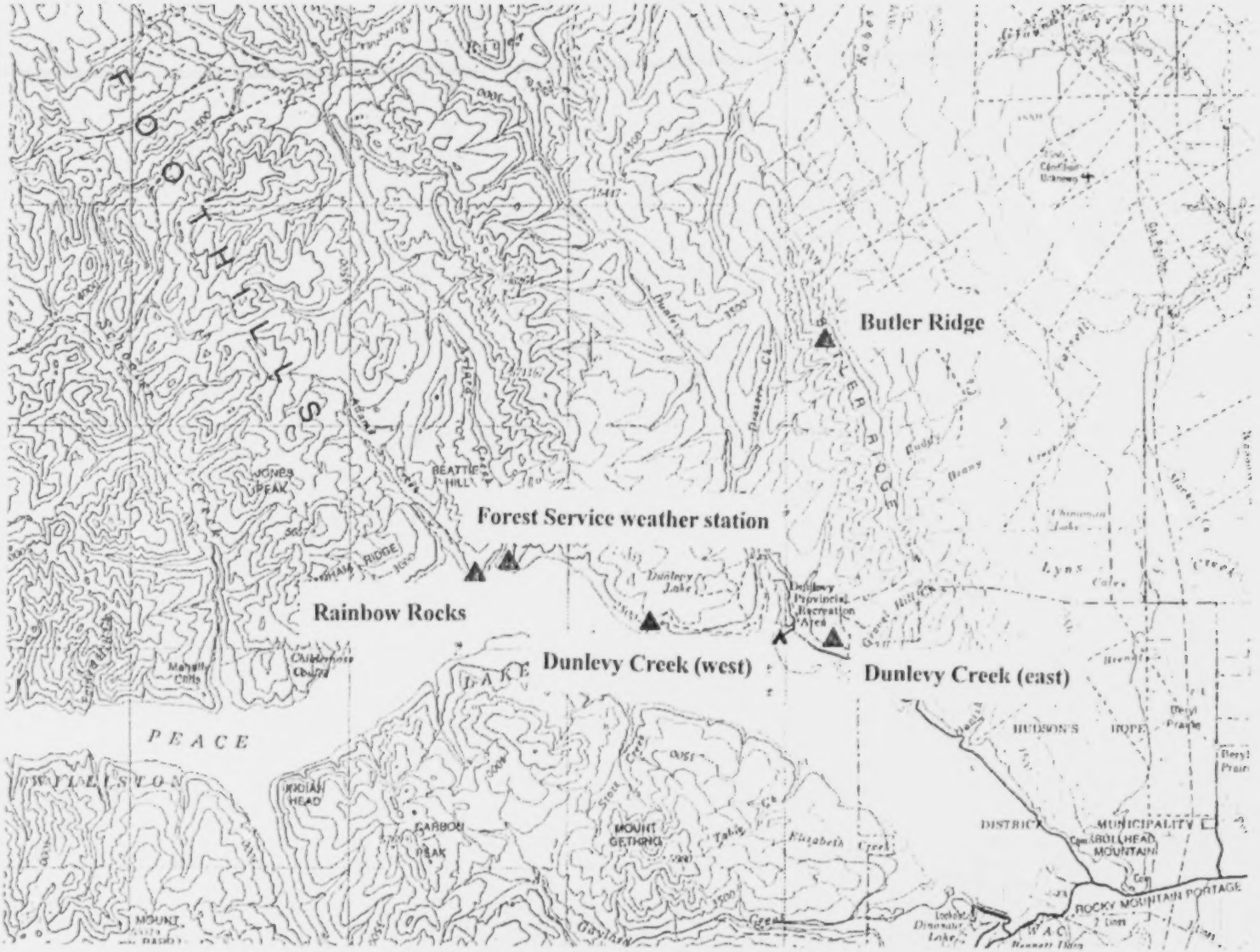
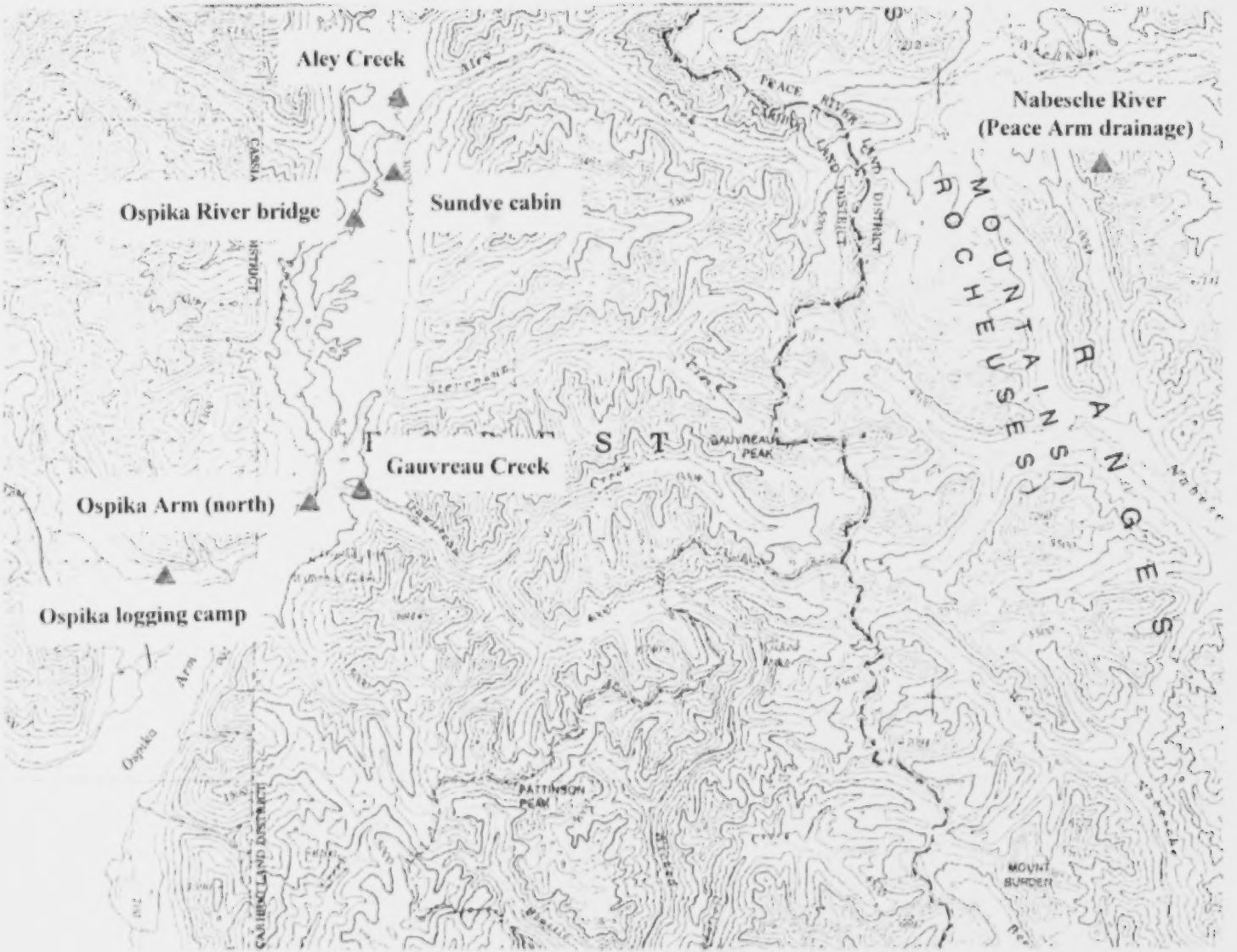
APPENDIX A. Locations of fecal pellet collection sites for Stone's sheep, Rocky Mountain elk and mule deer in the Ospika River and Peace Arm drainages (scale 1:250,000).

Peace Arm:
- Nabesche River [sheep] (see Ospika River Drainage map)
- Rainbow Rocks [sheep, elk]
- Forest Service weather station [elk, deer]
- Dunlevy Creek (west) [elk, deer]
- Dunlevy Creek (east) [elk]
- Butler Ridge [sheep]

Ospika River:
- Ospika logging camp [deer]
- Ospika Arm (north) [elk]
- Gauvreau Creek [elk]
- Ospika River bridge [elk]
- Sundve cabin [elk]
- Aley Creek [elk]



PEACE ARM DRAINAGE (scale 1:250,000)



OSPIKA RIVER DRAINAGE (scale 1:250,000)